MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2025.4.56.60

Comparison of Negative-Pressure wound Therapy and Conventional Dressing for Subcutaneous Abdominal wound Healing Impairment Following Abdominal Procedures

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Abstract

Improvements in surgical techniques and technologies have allowed surgeons to attain primary closure in a significant proportion of surgical procedures. Nonetheless, patient comorbidities, together with surgical variables, frequently complicate the primary closure of surgical wounds due to an elevated risk of complications. Negative pressure wound therapy (NPWT) is an established treatment option, however there is less evidence of effectiveness for subcutaneous abdominal wound healing impairment (SAWHI). To compare effectiveness and safety of negative pressure wound therapy and conventional wound treatment (CWT) in SAWHI. The present study was a prospective study conducted for a period of 10 months from January 2024 to October 2024 in Department of General Surgery, Sree Mookambika Institute of Medical Sciences, Kulasekharam. There were 34 patients (age >18 years) who had been evaluated for participation in the study by the local clinical investigators. These patients had open postsurgical abdominal wounds that did not heal by primary intention, as well as patients who had spontaneous wound dehiscence following abdominal surgery. Upon granting written informed consent, patients were assigned at random to one of two groups (NPWT group and CWT group). Patient demographic data, body mass index (BMI) and additional comorbidities were recorded. Postoperative sequelae, including infection, seroma, haematoma, skin and fat necrosis and skin dehiscence, were documented and analysed. In this study, 34 patients were recruited, with 17 (50%) receiving incisional NPWT (NPWT group) and 17 (50%) receiving conventional dressings (CWT group). The NPWT group exhibited a considerably faster and more frequent closure of wounds (34.07±4.53 days) compared to the CWT group (40.65±5.17 days). The overall wound complication rates were 3 (17.64%) and 10 (58.82%), respectively (p=0.031). The incidence of cutaneous dehiscence was 2 (11.76%) and 8 (47.06%), respectively (p=0.011). Both results attained statistical significance. NPWT served as an efficacious alternative to traditional wound management. NPWT markedly enhances the incidence of wound complications and skin dehiscence relative to traditional dressings.

OPEN ACCESS

Key Words

Abdomen, complications, negative pressure, wound care

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Received: 11th March 2025
Accepted: 18th April 2025
Published: 27th May 2025

Citation: Richard Samuel and Vinu Gopinath, 2025. Comparison of Negative-Pressure wound Therapy and Conventional Dressing for Subcutaneous Abdominal wound Healing Impairment Following Abdominal Procedures . Res. J. Med. Sci., 19: 56-60, doi: 10.36478/ makrjms.2025.4.56.60

INTRODUCTION

Surgeons today encounter a growing population of patients with intricate and persistent wounds[1]. This phenomena is probably attributable to several variables. Demographic shifts, including an ageing population and a heightened incidence of comorbidities, result in worse wound healing[2]. Subcutaneous abdominal wound healing impairment (SAWHI) presents as spontaneous dehiscence, the necessity for suture reopening, or open wounds post-surgery due to elevated infection risk or considerable tissue loss, while the abdominal fascia remains closed. Impairment of subcutaneous abdominal wound healing is frequently induced by surgical site infection. Additional factors encompass haematoma and seroma development, mechanical impediments to wound closure and different technical issues (e.g., suture failure)[3]. Three The most critical consequence with a high death rate is fascial dehiscence, characterised by the total separation of the wound, thereby exposing the underlying organs[4]. SAWHI is often managed using traditional wound dressings, utilised according to empirical data, patient preferences, physician expertise and the specific condition of the wound. Treatment modalities for open surgical wounds encompass negative pressure wound therapy (NPWT), which was initially established in its contemporary iteration in 1997 by Dr. Argenta and Dr. Morykwas[5]. NPWT involves the continuous application of negative pressure to the wound bed by a vacuum apparatus, facilitating the removal of excess tissue oedema and enhancing granulation tissue development. NPWT typically involves placing a dressing within the wound cavity and sealing the region with an adhesive film. A tube is linked to a vacuum apparatus that provides a regulated negative pressure between 50 mmHg and 125 mmHg. A negative pressure of 125 mmHg demonstrated a maximal enhancement in blood flow. Numerous fundamental investigations have established the beneficial effects of NPWT on wound healing[6,7]. In practical application, NPWT demonstrates its benefits by facilitating granulation tissue formation, minimising dressing change frequency by maintaining cleanliness in anatomically complex wounds, evacuating substantial amounts of wound exudate and reducing odour[8]. Nonetheless, NPWT may result in adverse events (AEs), which are typically preventable by proper application and sufficient precautions. The clinical evidence prior to this review primarily comprised clinician perceptions, case reports and series, short cohort studies and inadequately powered or low-quality randomised clinical trials across many clinical contexts.

Aims and Objectives:

- To compare effectiveness and safety of negative pressure wound therapy and conventional wound treatment in subcutaneous abdominal wound healing.

MATERIALS AND METHODS

Study Setting: Present study was conducted in Department of General Surgery, Sree Mookambika Institute of Medical Sciences, Kulasekharam.

Study Design: Prospective study.

Study Duration: 10 months from (January 2024 to October 2024). A total of 34 patients (age >18 years) with spontaneous wound dehiscence after abdominal surgery or active reopening of the suture and patients with open post-surgical abdominal wounds that could not be closed by primary intention were screened for study participation by the local clinical investigators were included. After providing written informed consent, patients were randomly allocated to one of the 2 groups (NPWT group and CWT group). Patient demographics, body mass index (BMI) and other comorbidities were noted. Patients in the NPWT group received primary fascial closure utilising biologic mesh. During the initial postoperative phase, the incisions were initially covered with nonadherent dressings. The black polyurethane foam was cut to be broader than the incision but smaller than the Adaptic to avert skin maceration and it was positioned along the whole length of the incision. The drape was designed to encompass the foam and an additional 3-5 cm of adjacent unblemished skin. The tubing and the T.R.A.C. pad were positioned in the lower portion of the dressing. In the instance of an inverted T incision, they were situated at the junction of the horizontal and vertical incisions. Ultimately, full adhesion and an airtight seal were achieved and negative pressure was commenced using vacuum-assisted closure therapy. The negative pressure maintained during the therapy was consistently steady at 125 mm Hg. The gadget was extracted on the fifth postoperative day. CWT Group underwent standard wound management. Postoperative sequelae, including infection, seroma, haematoma, skin and fat necrosis and skin dehiscence, were documented and studied. The complication rates in the two groups were analysed using chi-square tests for categorical variables and t-tests for continuous variables. A p value of <0.05 was deemed statistically significant.

RESULTS AND DISCUSSIONS

The average ages of patients in the NPWT group and the CWT group were 43.99±10.18 and 47.15±9.81 years, respectively. No significant variation in age was

observed between the two groups (p value=0.19), indicating strong age comparability in our study groups. Furthermore, there was no statistically significant variation (p=0.38) in gender between the study groups, indicating strong gender comparability within the study cohorts. The mean BMI was also found statistically not significant. Among the participants 7(41.18%) patients in NPWT group and 9(52.94%) patients in CWT group had history of diabetes. Table 1 and 2 shows the distribution of age and gender in the two study groups.

Table 1: Distribution of Age Group Among the Groups

Age group (Years)	NPWT group (N=17)	CWT group (N=17)
<30	2(11.76%)	2(11.76%)
31-40	3(17.64%)	2(11.76%)
41-50	6(35.29%)	7(41.18%)
51-60	4(23.53%)	5(29.41%)
>60	2(11.76%)	1(5.88%)

Table 2: Distribution of Gender Among the Groups

Gender	NPWT group (N=17)	CWT group (N=17)
Male	8(47.06%)	11(64.71%)
Female	9(52.94%)	6(35.29%)

The NPWT group exhibited a considerably faster and more frequent wound closure (34.07±4.53 days) compared to the CWT group (40.65±5.17 days). The overall wound complication rates were 3 (17.64%) and 10 (58.82%), respectively (p=0.031). The incidence of cutaneous dehiscence was 2 (11.76%) and 8 (47.06%), respectively (p=0.011). Both results attained statistical significance. The NPWT group exhibited low rates of infection, skin and fat necrosis, seroma and haematoma in comparison to the CWT group., however, no statistical significance was noted. (Table 3).

Table 3: Comparison of Outcome Variables Between the Groups

	NPWT group	CWT group	p value
Wound complications	3(17.64%)	10(58.82%)	0.031
Skin dehiscence	2(11.76%)	8(47.06%)	0.011
Infection	1(5.88%)	2(11.76%)	0.076
Skin/fat Necrosis	1(5.88%)	4(23.53%)	0.051
Hematoma	0(0%)	1(5.88%)	0.45
Seroma	0(0%)	3(17.65%)	0.053

The advantages of Negative in facilitating wound healing for complex open wounds following reconstructive surgeries have been thoroughly documented[9]. Since the advent of this therapy administered through a portable and practical device in the 1990s, the care of acute and chronic wounds has undergone significant transformation[10]. NPWT operates by exerting negative pressure on a sealed, airtight wound, facilitating a moist wound-healing environment, diminishing bacterial colony counts, enhancing granulation tissue formation, alleviating edema, stimulating cell-mediated immune responses, reducing blood vessel permeability and promoting angiogenesis and blood flow to the wound edges[11]. Two primary mechanisms are suggested to explain the enhanced rates of wound healing: a fluid-based mechanism involving the elimination of surplus interstitial fluid and deleterious inflammatory mediators and a mechanism characterized by microbial formation at the wound surface, which facilitates the approximation of surrounding skin and the subsequent release of growth factors, akin to the effects of tissue expansion[12]. The present study revealed a statistically significant reduction in the incidence of overall wound complications as well as skin dehiscence with the use of NPWT on closed surgical incisions. This device operates like a splint, alleviating midline tension on skin incisions and thereby reducing overall resistance and tension on the wound. It seems to absorb initial exudate and sustain a more sterile wound environment during the entire treatment period compared to standard dressings. Furthermore, the study noted that the incidence of skin/fat necrosis, hematoma, seroma and infection was reduced in group I relative to group II, albeit without achieving statistical significance. This is likely attributable to the limited sample size and the nature of the retrospective investigation, which indicates a correlation rather than a conclusive causal relationship. Stannard[13] did a randomized clinical trial with 263 patients to examine the application of incisional negative pressure wound therapy in individuals with high-risk lower extremity fractures. The study revealed a reduced frequency of wound dehiscence and overall infections in the NPWT group. In the meta-analysis by Tran[14], there were 1,723 patients, with 681 in the ciNPT group and 1,042 in the standard incisional treatment group. A large number of patients were obese, had diabetes and had a recent smoking history. The meta-analysis indicated a 51% reduction in the probability of surgical site infection. The likelihood of wound dehiscence diminished by 51%. No substantial reduction in risk was detected with ciNPT utilization concerning the outcomes of seroma, hematoma, reoperation and readmission. De Vries[15] enrolled 32 patients in the pNPWT cohort and 34 in the control cohort. The study group comprised clean-contaminated and contaminated procedures associated with enterocutaneous fistula, enterostomies, or diseased mesh. The median duration of pNPWT was 5 days (IQR 5-7). The overall incidence of wound infection was 35%. pNPWT correlated with a notable reduction in the postoperative wound infection rate (p=0.029). The incidence of incisional wound infections decreased from 48% to 7% (p<0.01), although the occurrence of subcutaneous abscesses remained similar in both groups. Furthermore, the pNPWT group required fewer interventions (p<0.001). In the study conducted by Gijón[16], 275 patients were recruited and analyzed, with 147 (53.5%) in the NPWT group and 128 (46.5%)

in the control group. Thirty-one (11.3%) surgical site infections and seventy-one (25.8%) other surgical site occurrences were recorded, significantly reduced in the NPWT group (p=0.005) and (p=0.02), respectively. The absolute risk reduction was 13% for surgical site infections and 12% for all surgical site events. The median duration of hospital stay was 3 days shorter in the NPWT group compared to the control group (9 days versus 12 days., p=0.03). In contrast to the current study, Garg[17] determined that closed incision negative pressure wound therapy offers no benefits over standard dressing for postoperative complications and length of hospital stay. Nonetheless, it markedly diminishes the frequency of clothing changes required, so alleviating both the psychological strain on patients and the workload on healthcare professionals related to daily dressing alterations. Seaman[18] also noted that ciNPWT did not correlate with a reduction in surgical site occurrences following abdominal wall reconstruction, but it did demonstrate a statistically significant reduction in postoperative seroma.

CONCLUSION

NPWT has significantly transformed wound management. This study investigated the impact of incisional negative pressure wound therapy on postoperative open abdominal wounds. The results demonstrated a reduction in wound complications and skin dehiscence associated with NPWT. Additional research may be conducted to evaluate the efficacy, cost-effectiveness and long-term consequences of NPWT in preventing postoperative wound problems.

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